Captive Red-necked Ostrich (*Struthio camelus camelus*) Intensive Starter/Grower Chick Rearing

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ABSTRACT

This study was conducted to evaluate, for the first time in Sudan, captive ostrich (*Struthio camelus camelus*) chick rearing. The parent red-necked flock (5 males and 7 females, 2-3 years old, at the second season of production) was stocked from the wild (Dindir National Park). Accommodation was in one breeding pen and feeding was on 14% crude protein and 09.23 MJ ME/kg. Thirty-eight hatched red-neck ostrich chicks, harvested in batches from a ratite incubator/ hatcher, were used in this rearing trial. Hatching chicks, after spending 3-4 days in the brooder, were considered starters for eight weeks before becoming growers for other eight weeks. Starters and growers were fed 23% and 16% crude protein and 14.75 and 10.11 MJ ME/kg, respectively. Each chick was weighed initially on the first day of the starter ration feeding and, thereafter, weekly until the end of the grower rearing period. Feed intake (kg/flock) was recorded on a daily basis by weight difference. The overall average performance values of starter ostrich chicks for 8 weeks (initial -8 weeks) were 4267g, 156.21 g and 01.21, for body weight, average daily gain and feed conversion ratio, respectively. The average daily dry matter intake was 148.51 g. The overall average performance values of grower ostrich chicks for 8 weeks (8-16 weeks) were 13443g, 200 g and 2.44, for body weight, average daily gain and the feed conversion ratio, respectively. The average daily dry matter intake was 455 g. The starter and grower periods were characterized by high growth rates and high feed conversion ratios. Starter ostrich chick mortalities, due to omphalitis and heat stress, were 10% of the flock. Mortalities during chick grower period were due to strangulation, impaction, injury and leg deformities. Total mortalities were 37% of the flock. Chick performance was fair compared to red-necked and African black starter/grower chicks.

Key words: Red-necked ostrich; starter/grower chicks; captive performance

INTRODUCTION

Ostrich chick rearing needs high expertise. Chick viability and consequent successful growth to slaughter age is a function of successful hatch, brooding and management. Edematous hatched chicks with non-absorbable yolk sacks in the long run cannot lead to sufficient performance levels or likely die earlier (Kreibich and Sommer, 1995 and Parker and Harper, 2002). Sell (1993) reported that the brooding facility should be dry, sanitary and well ventilated. Supplementary brooder heat should be provided to keep the temperature about 90^{o}F for the first two weeks and from the third week through the eighth gradually reduced to 75^{o}F. The first 10 days to 3 months of age are by far the most critical period of the chick live and chick diseases can be avoided by keeping them at the prescribed temperature, provide a well-balanced ration with good management so that they can eat greedily by 10 days of age and thus increase their chances of survival to three months of age and older **(**van Nickerk, 1996). Cogburn (2006) reported that chick livability is only 10% heritable, therefore the environment plays the largest role than genetics. Probably the biggest mortality of ostrich chicks is due to stress and great care should be taken to avoid any unnecessary stress due to heat, wind and overhandling. Chicks should be started on a proven ostrich (ratite) ration containing at least 26 percent protein (Sell, 1993). Alfalfa pellets, oyster shell and grit should be available to chicks at all times with ample clean water to ensure healthy and productive ostrich chicks (Parker and Harper, 2002). Ostrich chicks tend to eat too much and impaction is the most common reason for deaths. Enough exercise and mixing grit with feed may help to decrease incidences of impaction.

The live weight growth of ostrich chicks depends mainly on feeding and management. Kreibich and Sommer (1995) found that daily *ad lib*. feed intake of ostriches depends mainly on their liveweight and feed energy concentration. Cilliers (1998) reported feed intake of ostrich chicks aged 2, 4, 6 and 10 months to be 392, 474, 414 and 800 g respectively. Feed intake of growing ostriches amounts to 3-4% of their live weight, a value that diminishes towards the end of the growing period to approximately 2 - 2.5% which is for a fully grown ostrich. Rearing ostriches for slaughter with highly concentrated food may result in too rapid growth during the age of one to four months; and lead to deformation of the legs, especially in the joints (Kreibich and Sommer, 1995).

Degen *et al.* (1991) reported that there is a direct relationship of approximately 2.3:1 between water and dry matter intake and feed intake will be limited by any attempt to restrict water intake (Whithers, 1983). A highly intensive chick rearing system, it was especially important to feed the chick a balanced diet, and feed intake for the different stages of chick growth were 500 – 800 g for starters (8 -16 weeks), 800 –1450 g for growers (16 - 24 weeks) and 1450 – 1850 g for finishers (30-40 weeks) (van Niekerk, 1996a). Chicks lost weight during the first week of growth due to depletions of the yolk sac reserves and the release of water from subcutaneous edemas (Kreibich and Sommer,

1995**)**. They soon regained their hatching weight after approximately 7 days; while the chicks with a low hatching weight showed better (compensatory growth) gains during the first week than their companions with a higher hatching weight.

Daily body weight gain for the three stages of growth, starter (8 -16 weeks), grower (16 - 24 weeks) and finisher (50-65 weeks) were 214 – 223, 223 – 298 and 238 – 232 g, respectively (van Niekerk, 1996b). Similar growth stages were reported by Cilliers and van Schalkwyk (1994) to have daily gains of 196, 258 and 247 g in the Little Karoo. Kreibich and Sommer (1995) reported that the maximum daily gain in body weight of African blacks in Oudtshoorn approximate to 320 g/day reached after 163 days by cocks and after 175 days by hens, and after about 430 days a body weight of 90 kg was attained.

reported that for the different phases of physiological development the food conversion accounts for chicks to 1.4:1-1.6:1 for adolescent birds (4-6 months) 4:1- 6:1 and at the end of the growing period deceases to approximately 10:1 (Kreibich and Sommer, 1995a). Ostrich chicks up to an age of 3 months were extremely efficient feed converters requiring considerably less that 2 kg of feed dry matter per kg of live mass gain, while efficiency of feed conversion gradually deteriorated as the birds aged (van Niekerk, 1996b and van Niekerk and Maller, 1996). This decease took place irrespective of whether or not the ration was diluted by means of forages, as is the general practice in ostrich farming, and contributed to the decrease in feed conversion efficiency. Feed conversion ratio 2.34 - 3.59 for starter chicks, 3.59 -4.87 for grown and 6.09 – 7.97 for finishers (van Niekerk, 1996b).

MATERIALS AND METHODS

After spending 3-4 days in the hatchery room, 38 hatched red-neck ostrich chicks harvested in batches from the hatching experiment were used in this rearing trial. The starter chicks were lodged in a roofless pen of dimension's 9.5x5.5x3.5m with a concrete floor**.** A roofed carton cabin (3x2x1.5 m) with door was made in the southern side of the pen with aim to protect the chicks from solar radiation mid-day, cold nights and predators. The carton cabin was supplied with an overhead 100-watt lamp as a source of light and heat. Clean disinfected feed and water troughs were used. Starter ostrich chick ration (Table 1) was fed *ad lib* for 8 weeks. Clean water was provided *ad lib.* with 3 days interval prophylactic supplementation of water soluble vitamins and minerals. The starter chicks were considered growers after two months rearing and in the same pen, where the roofed carton cabin was abolished. Grower ostrich chick ration (Table 2) was gradually introduced and fed *ad lib.* for 8 weeks. Clean water was provided *ad lib.* Mortalities were reported throughout the starter and grower chick rearing periods and postmortem investigations were done on dead chicks. Each chick was weighed initially on the first day of starter ration feeding and thereafter weekly till the end of the grower rearing period. Feed intake (kg/flock) was recorded on daily basis by difference.

Statistical analysis

Data on performance of starter and grower chicks were subjected to one way ANOVA. Mean values were compared using the un-paired Student's *t*-test (Steel and Torrie, 1989)**.** Data on chick growth and developmental values were shown graphically as trace. Per cent values were used in expressing chick mortalities.

RESULTS

Figure 1 shows average growth curve of day-old ostrich chicks up to 15 days. Weight loss was evident till the fifth day when growth becomes progressive at estimate of 0.75 coefficient of growth reaching over 2 kg in 10 days. Table 3 shows starter ostrich chick mortalities during the rearing period. Over 10% of the flock was affected either with omphalitis or heat stress. Each of other affections were over 2% of the flock. Table 4 shows grower ostrich chick mortalities during the rearing period. Total affections were 37% of the flock. Table 5 shows the average performance values of starter ostrich chicks initially (hatching weight) and up to 8 weeks of age. All performance entities were of significant ($p<0.05$) treatment effect. Average body weight over 8 weeks period was 4267.00 ± 2941.73 g, average daily gain was 156.21 ± 97.33 g, average daily dry matter intake was 148.51 ± 79.35 g and feed conversion ratio was 01.21± 00.63. Table 6 shows the average performance values of grower ostrich chicks initially at 8 weeks and up to 16 weeks of age. All performance entities were of significant ($p<0.05$) treatment effect. Average body weight over 8 weeks period was 13443.49 ± 3704.02 g, average daily gain was 200.60 ± 55.58 g, average daily dry matter intake was 455.13 ± 197.85 g and feed conversion ratio 02.44± 00.75.

DISCUSSION

Day-old ostrich chicks exhibited a drop in weight up to the 5^{th} days and then their growth became progressive at a high rate. Low weight hatching chicks showed better gains during the first week than high weight hatching chicks (Deeming and Ayres, 1994). This decrease in the weight was attributed to the loss in the yolk sac weight whilst nutrients were consumed and/or to the release of water from subcutaneous edemas. Exercising of young ostrich chick, facilitates this loss. Kreibich and Sommer (1995) and Shanawany and Dingle (1999) reported that plenty of exercise from a very young age to the ostrich chick was needed, and the earlier the better. It helps to reduce impaction of the digestive tract by increasing its motility, enhance blood circulation and assists growth. Long runs availed to the chicks are perhaps the most widely used method of exercise.

Starter ostrich chick exhibited high growth rate over 8 week's period and all performance entities were significant. The body weight increased greatly from less than 1

kg to more than 8 kgs during 8 weeks with an average daily gain around 150 g. Kreibich and Sommer (1995) found rapid growth chicks during the age of one to four months. Rearing ostrich with high concentrated feed stuffs resulted in too rapid growth during the age 1-4 months (Hallam, 1992 and Cilliers, 1994). Angel (1993) confirmed that chicks fed a protein- rich feed in the first 56 days of their live weight showed significant improvement in weight gain. Average daily feed intake had slightly dropped during the first week and then increased with advancing age and likewise the average daily dry matter intake. During the first 10 days, chick feed intake is low and the birds still uses the store yolk and by feeding the limited rations the yolk can be broken down faster (Kreibich and Sommer, 1995). Thus feed intake of ostrich chicks depend only on their current live mass and energy density of the rations.

The period of starter ostrich chick high growth was also characterized by high (1.21 + 00.63) feed conversion. Kreibich and Sommer (1995) recorded a F.C.R. of 1.4 or 1.6 for starter African black ostrich chicks which compares well with our red-necked experimental findings. Most mortalities that affected the starter chicks were either of intrinsic aetiology pertaining to the non- reduced yolk sac (omphalitis) or generalized edema of the post hatch. Other mortalities were of extrinsic aetiology like heat stress or gravel impactions due to the non-selective nature of the starter chick. Improper management led to losses due to drowning or severe injuries. Chick dullness was known to be of obscure aetiology when the chick fades to death (Agab, 2005; Perelman, 1993). All performance values of the grower ostrich chicks (8-16 weeks of age) were of significant treatment effect. The body weight of the growers had increased successively with advancing age but the rate of increase was lower than that attained by the starters with an average daily gain around 200 g. The average daily gain decreased in the 10^{th} week and then gradually increased towards the 16^{th} week. This was due first to flip to the grower diet without an adaptation period and second to the dietary composition.

The average daily dry matter intake was 3.39% of the grower chick live weight. This value is similar to Kreibich and Sommer (1995) who showed that *ad lib.* feed intake of the growing African black ostrich chicks amounted to 3-4% of their live weight. Conversely Farzi (1993) found feed intake as 1.5-3% of the growing ostrich chicks live weight which increased with the advancement of live weight. These differences were due to variations in the chick live weight and feed dry matter and energy concentration. As in monogastrics, increase in feed intake is related to the dietary energy dilution by fiber elements, as chicks will tend to eat to energy intake limit. Swart (1988) highlighted the modifications in the hindgut of the ostrich, as being indicative of a significant fermentative digestion. Efficiency of VFA absorption in the hind gut was low and consequently energy utilization. He was able to prove that supplementing dietary energy by increasing concentration of crude fiber had a negative effect on the utilization of ME in growing ostriches. The trend of feed conversion ratio for the grower chicks decreased from 2 to 3.8, due to a decrease in efficiency utilization of nutrients and a decrease in

energy concentration of the grower diet. The overall grower ostrich chick feed conversion ratio was 02.44 ± 00.75 for the 16 weeks period, which was less than the starters. Respective Little Karoo values were 2.0, 3.8 and 5.5 (Cilliers and Van Shalwyk, 1994). Cogburn (2006) observed that feed efficiency was 40% heritable even though the environment played a large portion; genetics were the main factor. It is feasible to invest more feed in a bird if that bird produces more products.

Grower chick mortalities were all of extrinsic aetiologies related to the environment or to management aspects. Errors in fence constructions can lead to injuries and strangulations. Airborne polythene bags, paper or miscellaneous items may be engulphed by swallowed chicks may cause impactions or death. Occasionally slippery grounds after rains or faulty water run offs can cause leg problems as the weight of the chick increases (van Niekerk, 1996a). Affections of environmental origin seem to be of equal probabilities.

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Table1. Per cent composition (as fed basis) and calculated chemical composition (dry matter basis) of starter chick rations**.**

Ingredient	%	**Component**	%
Sorghum	65.00	Dry matter	95.00
Groundnut meal	13.00	Crude protein	22.85
Sesame meal	15.00	Crude fiber	04.33
Super concentrate	05.00	Ether extract	04.87
Bone meal	01.34	Nitrogen-free extract	56.93
Oyster shell	00.38	Ash	06.02
Common salt	00.25	Ca	01.34
Methionine 97%	00.03	P	00.79
Total	**100.00**	Energy(MJ ME/Kg)*	14.75

* Calculated according to Lodhi *et al.* (1976).

Table 2. Per cent composition (as fed basis) and analyzed chemical composition (dry matter basis) of grower chick rations.

Ingredient	%	**Component**	%
Sorghum	45.00	Dry matter	95.20
Groundnut meal	02.00	Crude protein	16.34
Fish meal	04.00	Crude fiber	16.44
Lucerne	25.00	Ether extract	02.94
Groundnut hulls	12.50	Nitrogen-free extract	48.13
Bone meal	06.00	Ash	11.35
Vitamin/mineral mix	05.00	Ca	03.49
Common salt	00.50	P	01.17
Total	**100.00**	Energy(MJ ME/Kg)*	10.11

* Calculated according to Lodhi *et al.* (1976).

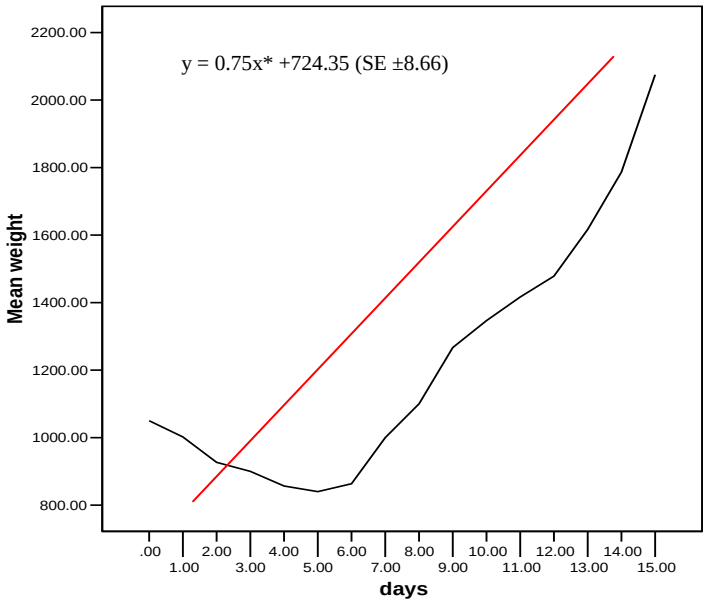

Fig 1. Average growth curve of day-old ostrich chicks up to 15 days.

Table 3. Mortalities during the starter ostrich chick rearing period.

Cases	Mortalities			
	No. of cases	% of total cases	% of flock size	**Notes**
Dullnes	1	09.090	02.63	Obscure aetiology
Drowning	1	09.090	02.63	In the waterer
Heat stress	4	36.365	10.53	Extreme heat on first transport to rearing pens
Impaction (sand and gravel)	1	09.090	02.63	During the non-selective feeding period
Omphalitis	4	36.365	10.53	Non-reduced yolk sac with generalized oedema
Total	**11**	**100.00**	**28.95**	

Table 4. Mortalities during the grower ostrich chicks rearing period.

Cases	Mortalities			
	No. of cases	% of total cases	% of flock size	Notes
Strangulation	2	20.00	07.41	Sudden head withdrawal from inbetween meshwire openings
Impaction (Plastic bags)	2	20.00	07.41	Air-borne to the pen.
Injury	4	40.00	14.82	Friction with fence and/or protruding metal or wood
Leg deformity	2	20.00	07.41	Slippery grounds after rains.
Total	**10**	**100.00**	**37.05**	

Table 5. Analysis of variance and average (mean ± s.d.) performance values[1] of starter ostrich chicks' age groups up to 8 weeks.

Item	**F-**	**Mean ± s.d.**

	value#	Week 0	Week 2	Week 4	Week 6	Week 8	Overall Average
Body weight (g)	**141.46 ***	831.25 ±117.89	1790.00 ±205.43	4213.75 ±502.79	5837.50 ±892.73	8662.50 ±1304.87	**4267.00 ±2941.73**
Total weight gain (g)	**39.10***	325.00 ±131.80	526.25 ± 66.96	1352.50 ±243.18	1075.00 ±483.29	2063.38 ± 434.38	**1068.43 ± 695.43**
Average daily gain (g)	**51.02***	46.44 ± 18.83	75.18 ±09.78	193.21 ± 34.74	171.43 ± 47.07	294.79 ± 62.08	**156.21 ± 97.33**
Average daily feed intake (g)	**42.27***	91.54 ± 13.32	86.12 ± 11.22	153.47 ± 27.58	155.34 ± 42.68	296.07 ± 62.42	**156.51 ± 84.24**
Average daily dry matter intake (g)	**42.99***	87.29 ± 11.99	81.82 ± 10.64	145.79 ± 26.20	147.62 ± 40.56	280.03 ± 57.81	**148.51 ± 79.35**
Average daily energy intake(MJ)	**38.14***	01.32 ± 00.23	01.27 ± 00.17	02.15 ± 00.39	02.29 ± 00.63	04.25 ± 00.95	**02.26 ± 01.21**
FCR	**17.93***	02.21 ± 00.85	01.15 ± 00.01	00.79 ± 00.00	00.91 ± 00.00	01.01 ± 00.00	**01.21 ± 00.63**

1 = Done on 8 chicks of one and the same batch hatched from the first season lay.
# At (4,35) d.f. * Denotes F-value significant at $p < 0.05$.

Table 6. Analysis of variance and average (mean ± s.d.) performance values[1] of grower ostrich chicks' age groups up to 16 weeks.

Item	**F-**	**Mean ± s.d.**

	value#	Week 8	Week 10	Week 12	Week 14	Week 16	Overall
Body weight (g)	**48.63***	8662.50 ±1304.87	10672.75 ±1255.59	13119.75 ±1363.82	15969.87 ±1558.39	19136.13 ±1888.76	**13443.49 ±3704.02**
Total weight gain (g)	**00.95**	2063.38 ± 434.38	1061.13 ± 189.20	1290.88 ± 161.60	1463.50 ± 191.31	1627.50 ± 224.74	**1508.89 ± 953.15**
Average daily gain (g)	**18.37***	294.77 ± 62.06	151.75 ± 27.10	185.88 ± 22.79	209.13 ± 27.18	240.00 ± 30.61	**200.60 ± 55.58**
Average daily feed intake (g)	**53.66***	296.07 ± 62.42	308.38 ± 52.71	424.13 ± 52.87	542.38 ± 101.58	883.63 ± 122.07	**478.02 ± 207.54**
Average daily dry matter intake (g)	**55.60***	280.03 ± 57.81	293.75 ± 50.17	399.00 ± 54.38	516.13 ± 96.82	842.38 ± 116.65	**455.13 ± 197.85**
Average daily energy intake (MJ)	**54.31***	04.31 ± 00.83	03.12 ± 00.53	04.29 ± 00.53	05.45 ± 01.02	08.93 ± 01.23	**05.02 ± 02.04**
FCR	**290.55***	01.01 ± 00.00	02.11 ± 00.00	02.30 ± 00.00	02.70 ± 00.00	03.80 ± 00.00	**02.44 ± 00.75**

1 = Done on 8 chicks of one and the same batch hatched from the first season lay.

At (8,63) df. * Denotes F-value significant at $p < 0.05$.